A CONCRETE CAISSON WELL

By
G. E. P. Smith*

WELLS are so common in every part of the country that they rarely occasion any interest or comment. Little attention is paid to their construction and old types are still in vogue. The increase of pumping for irrigation in the West is calling for great numbers of wells of a cost suited to the individual purse, but with a water supply more comparable with that of a municipal waterworks. It is little wonder, therefore, that ranchers case their wells with plank and that the average life of these wells is less than ten years.

A type of well which is very common in Arizona consists of a large timber-cased excavation down to the water level and a small perforated cylinder of riveted boiler steel sunk from six to fifteen feet into the water. Such steel cylinders are expensive, very limited in size, and difficult to sink. They have to be loaded with weights or jacked down, and frequently lose their shape, making further sinking impossible. Moreover, the timber casing above the water level decays rapidly and instances of unexpected cave-ins are very common.

The irrigator's well must penetrate the water gravels sufficiently to give a large percolating area. It should be built of durable materials, should be easily sunk, and of very moderate cost. In the effort to meet these conditions a concrete caisson well has just been tried at Tucson, Arizona.

The concrete casing is circular, eight feet in diameter inside. It was built at the surface of the ground in sections three feet high, and was sunk as an open caisson by excavating the interior. The concrete wall is eleven inches thick at the base and eight inches thick at a height of eighteen feet. This provides a batter of one inch in six feet on the outer face of the wall. Above the eighteen feet height the eight inch thickness is carried up for six feet. The forms used in constructing the wall are shown on opposite page.

The shoe is built of two inch plank, sawed into segments and spiked together. The outer edge is protected by a small angle-iron fastened with lag screws. The lower face is five inches wide. It is thought that the caisson was controlled much better on this shoe than it could have been on a sharp cutting edge.

Reinforcement, both vertical and circular, is provided. The vertical rods at the bottom are plain bars one-half inch square in section, and spaced about thirty inches apart. They are bolted through the shoe. Higher up is some old scrap pipe, and near the top a few Johnson bars. The circular bands are of worn-out hoisting cable from three-eighths to three-fourths inch in diameter, and spaced at intervals of one foot. The ends are lapped

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and wired in the first few rings, but above them the cable is wound up spirally through the concrete.

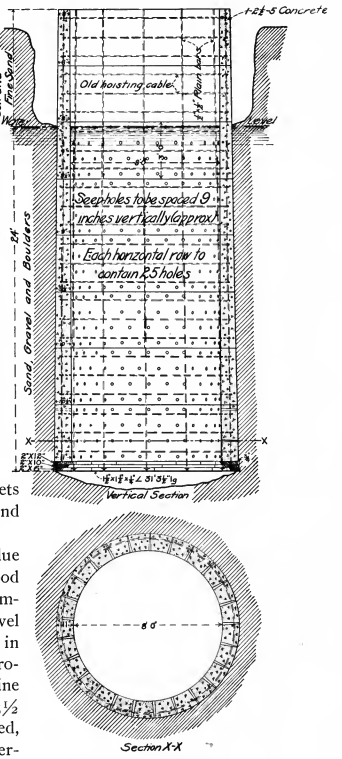
The concrete proportions were 1 : 2½ : 5 by volume, allowing 3.8 cubic feet per barrel of cement, and a high grade Pennsylvania cement was used. Sand and gravel were hauled from the nearby river until good material from the excavation was available. Especial care was exercised in mixing and placing the concrete, for therein rested largely the safety and strength of the caisson. After the first three rings or sections were built, they were allowed to harden for eight weeks before sinking commenced.

Seep-holes were easily provided by means of cast iron taper pins thrust through the inside form and against the outside form. They were withdrawn as soon as the initial set had taken place. Later corks of a cheap quality were used to temporarily stop the holes, so that during the sinking the inward flow of water under the shoe was very strong and of some assistance.

Recessed holes were left for timber sets which might later be needed to support and brace the pump frame.

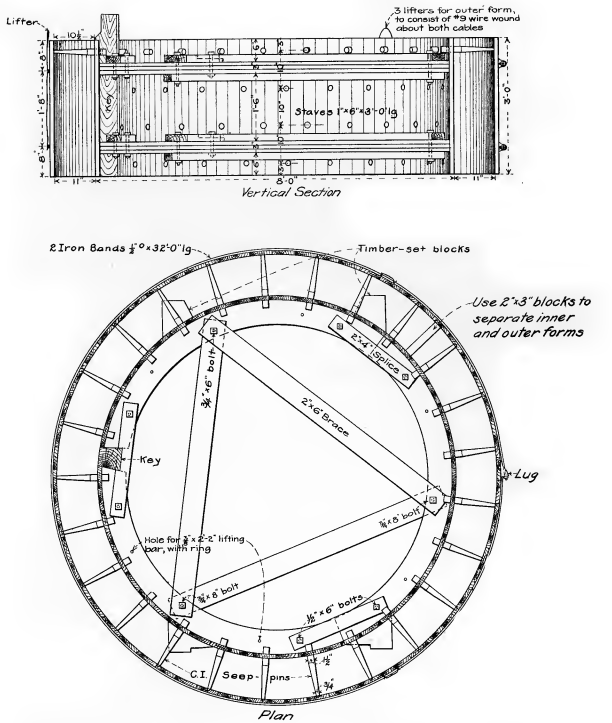
The only difficulty encountered was due to the very strong inflow of water—a good fault in a well. When work was commenced in March the ground water level stood at six feet below the surface, but in May and June when sinking was in progress the ground water level was from nine to eleven feet below the surface. A No.3½ Jackson centrifugal pump was first used, but was soon abandoned and a No. 6 vertical centrifugal pump was put in. This was overspeeded by lagging the pulley, and the engine was run at utmost speed. When the summer rains commenced the ground water level began to rise rapidly making further sinking impossible.

Many large boulders were encountered



CONCRETE CAISSON WELL.

The open cut was first excavated to water level. Three sections or rings were then built and allowed to harden eight weeks. As the curb was lowered additional sections were built at or near the surface. The shoe consists of 2-inch plank protected by a small angle-iron.



FORMS FOR BUILDING CAISSON WELL CURB.

The inner form is in three sections, rigidly braced. The outer form is tapered one-half inch and is adjusted to the successive sections by removing half a stave each time.

under the shoe, several being over twenty inches in longest dimension. They were readily undermined and brought into the well, a long pick being found most efficacious for this work.

The caisson frequently got out of plumb, but it was easily righted again by excavating under the high side. Two plumb lines were suspended on the wall 90° apart. The best advice seemed to be to keep the center high,

RAISING THE FORMS FOR CONCRETE WELL CURB.

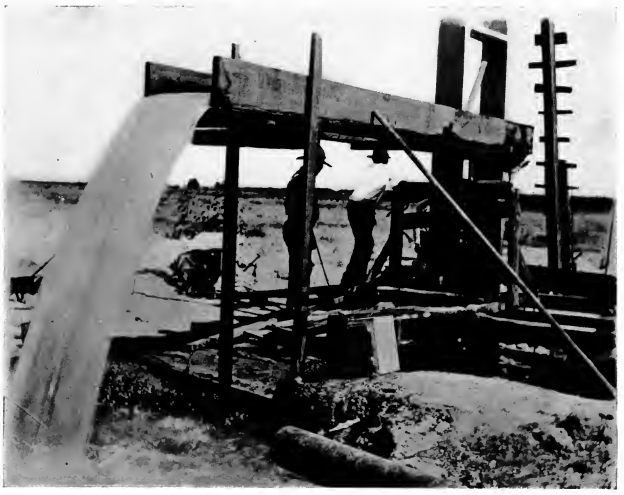
The inner form has just been lifted and rests on spikes driven in the space-blocks. The key, which has been removed, belongs just in front of the boy. The outer form has been loosened ready to raise.

excavate at the edges, and watch the plumb lines. At no time did the caisson hang, and the friction factor (not considering the slight taper) was therefore very low, less than 100 pounds per square foot. After the forms were removed from each section a wash of neat cement was applied on the outer surface. It is believed that the caisson could have been carried down much deeper without applying extraneous loads.

The most severe test occurred when several cubic yards of soil, becoming wet from the drip under the discharge trough, slid down against the caisson and shook it as from a heavy blow. No harm was done and the ring of the concrete when struck with a hammer continues to indicate its solidity.

The cost was very close to $550, but cost data would be very misleading on account of the unusual prices. For example, the cost of the cement was $5.25 per barrel. The work was done by an intelligent and painstaking foreman with Yaqui Indian laborers.

Several improvements could be made if the work were to be repeated. Metal forms would be preferable and the greater cost would be justified if the forms could be used on many wells. A dredging pump with hose suction



SINKING THE CONCRETE WELL CURB.

This stream of water is sufficient to irrigate 300 acres of land. Shortly after the date of this photograph the pump was lowered five feet, doing away with the needless lift.

could be used to excavate the sand. A controlling guide ring at top would be a safeguard if thick strata of quicksand were to be passed, and a more pointed shoe would be preferable if very hard or tough material were to be cut through.

The well in itself is a small piece of construction, but it is a type, and concrete caisson wells in the future are likely to prove superior to all other forms. Two wells, similar to the above, but deeper, have recently been built in California by the Edison Electric Co. Two hundred of them are needed in the Santa Cruz Valley alone for irrigating purposes and several for domestic supplies.

The well described was built under the auspices of the University of Arizona Agricultural Experiment Station.

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